Rainforest bat conservation: Unique problems in a unique environment

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The article by Les Hall (*Australian Zoologist*, previous issue) shows wisely that bats in Australia require special attention to their conservation requirements, since their needs are often quite different from those of other Australian mammals. However, information that has been recently obtained shows that the bat community that utilizes rainforest is uniquely specialized and some frugivorous species appear to be closely involved in the regeneration and survival of this major habitat itself. In this article I will call on specific examples that have resulted from intensive research conducted primarily in the rainforest tract that extends from Cooktown to Townsville, a considerable part of which is now listed as a World Heritage Area.

Consequences of Rainforest Fragmentation and Dissection

In tropical north Queensland the two major vegetation complexes (rainforest and tropical woodland) are distinguished primarily by the openness of their canopies. The bat fauna of this region comprises over 30 species and is similarly divided into communities that only occupy dense rainforest, those that only occupy open eucalypt woodlands, and those that occupy both.

These bat communities are distinguished by their flight characteristics — the dense structure of rainforest only "allows" slow-flying, highly manoeuvrable species to reside and forage there, but these species don't cope well with the longer distances of open forest. Conversely, open forest species that can accommodate resources with greater spatial separation, typically have fast direct flight, but are unable to manoeuvre in rainforest. The species that can occupy both types of forest are in between the two communities in their flight patterns.

Crome and Richards (1988) showed that when rainforest is opened, many species from the open woodland community invade the newly created spaces in this dense vegetation, a habitat that they cannot normally manoeuvre within. Crome and Richards observed that open forest bats can invade rainforest within six weeks of it being opened, the gaps in the canopy being caused in their case by logging roads and snig tracks, but the same would apply when rainforest is open for real estate development and normal road construction.

The question still to be answered though is how detrimental to rainforest bats is the invasion of their habitat by competitors? Forestry guidelines allow the removal of 30% or more of the canopy, so one would assume that the resources and/or foraging space available to the rainforest community would be similarly reduced. Would this affect their long-term survival, their reproductive output, or their breeding success? These questions as yet remain unanswered.

Examples of Specialist Bats of the Rainforest

To illustrate how unique rainforest bats are when compared with others, we should take the example of two insectivorous bats in particular. These are two bats from the guild that gleans insects from foliage and other substrates — the Golden-tipped bat *(Kerivoula papuensis)* and the Tube-nosed bat *(Murina florium)*. The Golden-tipped bat is one of the most manoeuvrable of Australia's bats. As well as showing great control in flight it can also hover. It is also one of our rarest bats, and appears to be restricted to rainforest and other densely vegetated habitats, where it appears to specialize in feeding upon Orb spiders and others that sit in their web awaiting their own prey. With such a prey specialization, any loss of understorey vegetation, for example through logging or forest fires, must affect prey availability, an hypothesis that needs to be examined.

The insectivorous Tube-nosed bat is remarkably adapted to life in rainforests, but particularly in upland regions where mist and dampness is common. This bat roosts by wrapping its wings around its body like an umbrella (as opposed to folding them against the sides as other small bat do), and folds its tail over as added protection from water droplets. Less than ten of these bats have ever been caught in Australia, and their counterparts in Asia are similarly rare. This adaptation to misty rainforests leads to the presumption that it is not found elsewhere, but this type of rainforest is uncommon in tropical Queensland. Of further concern is that the major locality for this species is just outside the boundary of the area listed as World Heritage, so there is no security for its habitat.

The Mutualism Between Fruit Bats and Rainforest

Until a few years ago our understanding of the role of fruit bats in Australian ecosystems was very limited, since the small amount of previous research had been restricted to investigating their role as pests to the fruit industry.

Several major studies of individual species have recently been completed, including Spectacled flying foxes, *Pteropus conspicillatus,* in tropical Queensland (Richards 1990a,b), Little red flying foxes, *P. scapulatus,* in the Northern Territory (McCoy, unpublished), and the Grey-headed flying fox, *P. poliocephalus,* in New South Wales (Parry-Jones and Augee, unpublished). The latter two studies showed that these species, which forage primarily in eucalypt forest, were not such a menace in orchards, and appear to have an important role in the pollination of *Eucalyptus,* the most common and widespread tree genus in Australia.

The Spectacled flying fox was shown to never roost further than 6 km from rainforest and, as a result, has the most restricted distribution of our four mainland species. Richards (1990b) also found that this species ate four times the fruit species than it did flower species, but of more importance was the fact that the majority of fruit species had a high night visibility — they were light coloured and could be easily found by these fruit bats with their high visual acuity (Calford *et al.* 1985). It is interesting that native fruit pigeons, another major frugivore group, mainly forage upon the bright coloured fruits (especially red colours) that flying foxes rarely take.

Of more importance is that a great deal of research overseas (Janzen 1983; Marshall 1983) has shown that rainforest trees "need" their seeds to be taken away from the parent to enhance survival, apparently by reducing competition for light and other resources. The Spectacled flying fox contributes to this by removing seeds over relatively long distances, partly by excreting small seeds as other dispersers do, but primarily through territorial behaviour.

This transpires when groups of flying foxes congregate in a feed tree and establish territorial space which is actively defended. Richards (1990b) termed these animals as "residents", as opposed to those that later invade these territories, called "raiders". When either the raider or resident is evicted from the tree, the behaviour of most importance is that they usually take a fruit with them, this fruit being either dropped or consumed at a distance from the parent (source) tree, thereby fulfilling the scenario illustrated by Janzen (1983) and others. Van der Pijl (1957) showed that many tree species were specialized to attract bats as seed dispersers, particularly in their presentation of fruit on the tree periphery. From a conservation point of view, these biological patterns show that there is a significant mutualism between these bats and rainforest.

Of concern though, is that Spectacled flying foxes are lumped as pests with other species such as Little reds, Blacks and Grey-headeds that occasionally raid orchards when natural food is in short supply. This has resulted in the Spectacled flying fox being removed from the protected fauna list in Queensland (their range state) and are regarded as vermin to be dealt with accordingly. There is some evidence (Richards, unpublished) to show that populations of Spectacled flying foxes are declining in north Queensland, and this is the only place in Australia where they are found, being distributed extralimitally in Papua New Guinea.

New that we know some aspects of the biology of this species, and particularly that it is only distributed where tropical rainforest is found, there is much cause for concern that it does not enjoy the security that other protected fauna does.

A Case for Concern — The Endangered Ghost Bat

Although Australia's only predatory bat appears to have widespread distribution across northern Australia, covering a range of environments that include rainforest, latest calculations indicate that there may be as few as 4 000 of these bats left (Phillips 1990). Found nowhere else in the world, the Ghost bat is restricted to only 10 or so maternity sites, and these appear to have a microclimate that suits their needs in pregnancy and rearing young.

Very few of these sites are secure in National Parks or reserves, so the risk of destruction of entire breeding populations is great. Deliberate destruction of caves has already happened at Mt Etna near Rockhampton in Queensland, and a major site at Pine Creek in the Northern Territory, in an abandoned gold mine, is at risk of collapse.

This species requires urgent research, especially to determine whether there is a genetic connection between the populations that are centred on maternity roosts, and to learn the reasons for the deline in numbers.

A Final Note

One of the greatest problems facing bat conservation in Australia today is a lack of basic information on virtually all of the species, and a lack of our understanding of the interactions of bats with forests, particularly at the community level. Unfortunately, even though bats constitute over one-quarter of our mammal species, they are the least studied of our faunal groups. The difficulty of studying these animals is now not an excuse as it was in the past, and we are so zoologically naive in this respect that it is not uncommon to discover new species annually.

By way of example, when Strahan (1983) edited the "Complete Book of Australian Mammals", 58 species were described. There are now 65 species that are taxonomically recognized, with another four that are yet to be added after description. There is another species from the Windsor Tableland rainforests of north Queensland that has been identified by its ecolocation call structure as being a small Sheath-tail bat, but since it still hasn't been caught it remains unidentified at species level. In fact, it is difficult to conduct fieldwork without tripping over a species previously undescribed or known from this country, which simply exemplifies that there are not enough researchers to cover such a large task, so how then can we expect to confidently state that our summary of conservation problems is finite. The expression "just scratching the surface" is an excellent position statement, and we can certainly hypothesize that there are many more conservation problems that are yet to unfold, but conversely, there are probably many that we have missed and will never recover.

REFERENCES

CALFORD, M. B., GRAYDON, M. L., HUERTA, M. F., KASS, J. H. AND PETTIGREW, J. D., 1985. A variant of the mammalian somatopic map in a bat. *Nature* **313:** 477-79.

CROME, F. H. J. AND RICHARDS, G. C., 1988. Bats and gaps: Microchiropteran community structure in a Queensland rainforest. *Ecology* **69:** 1960-69.

JANZEN, D. H., 1983. Food webs: Who eats what, why, how and with what effects in a tropical forest? Pp. 167-82 in *Ecosystems of the World 14A. Tropical rainforest ecosystems. Structure and function* ed by F. B. Golley. Elsevier Scientific Publishing: New York.

MARSHALL, A. G., 1983. Bats, flowers and fruit: Evolutionary relationships in the Old World. *Biological Journal of the Linnean Society* **20:** 115-35.

PHILLIPS, W. R., 1990. Priorities for Ghost bat *(Macroderma gigas)* conservation and management. Unpublished report. Australian National Parks and Wildlife Service: Canberra.

RICHARDS, G. C., 1990a. The Spectacled flying fox *Pteropus conspicillatus* (Chiroptera: Pteropodidae), in north Queensland. 1. Roost sites and distribution patterns. *Aust. Mammal.* **12** (in press).

RICHARDS, G. C., 1990b. The Spectacled flying fox, *Pteropus conspicillatus* (Chiroptera: Pteropodidae), in north Queensland. 2. Diet, seed dispersal and feeding ecology. *Aust. Mammal.* **12:** (in press).

STRAHAN, R. (Ed), 1983. *The Australian Museum Complete Book of Australian Mammals.* Angus & Robertson: Sydney.

VAN DER PIJL, L., 1957. The dispersal of plants by bats (Chiropterochory). *Acta Botanica Neerlandica* **6:** 291-315.

Response to Comments on Bat Conservation in Australia

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The supportive comments on my bat conservation article by reviewers and their suggestions for additional areas requiring attention were most welcome.

There is obviously a lot more to do with bats given the lack of so much basic knowledge (e.g., species taxonomy — Baverstock; distribution and ecophysiology — Richards and Thompson) before we can establish a proper set of priorities for their conservation.

Several of the reviewers (Richards, Thompson, Woodside) pointed to the need for more ecological studies on forest bats. There is a weakness in my article on the importance of forest bats, not only for their own conservation but for forest management as well. This reflects my bias over the years to be involved mainly with cave-dwelling bats. The research conducted by the ANU group, the New South Wales NPWS group studying south coast woodchips, Arthur Rylah and CALM (WA) have made important contributions to forest bat ecology. Their studies are relevant to conservation of uncommon species (e.g., *Phoniscus papuensis*) and have shown that bats can be used as excellent indicator species in forest management (e.g., *Nyctophilus gouldii*). It would be appropriate for these groups of researchers to review their findings and plot future directions.

I don't intend to set up a new set of priority projects. The 15 projects I suggested were to show what worthwhile research could be undertaken in relation to bat conservation. They are projects which are ready to go and were aimed at not only bat researchers but interested public and government officials. There are projects for everyone.

Woodside re-organized the projects into logical areas of research — an approach which has merit and would be appreciated by government and planning authorities. Her priorities move from public awareness to resource allocation at the government level. My only criticism of her priorities is that individuals cannot see their project as meaningful — given the wide scope of the listing. It is essential, however, that this type of programme be presented to the appropriate authorities. It needs to be